

COVID-19 Vaccine Hesitancy: Demographic Factors, Geographic Patterns, and Changes Over Time

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Key Points

- Hesitancy around COVID-19 vaccines is a significant challenge for public health.
- Vaccine hesitancy has decreased across most demographic groups between January and March 2021, but the percent of respondents indicating that they will “definitely not” get a vaccine, referred to as the “strongly hesitant,” has remained relatively unchanged over time.
- The largest declines in vaccine hesitancy were observed among those ages 18-24 (26% in January 2021 to 18% in March 2021) and Blacks (34% in January 2021 to 18% in March 2021).
- Vaccine hesitancy rates were lowest on the West Coast and in the Northeast, and highest in the South, Great Plains, and Alaska.

Introduction

As of May 19, 2021, three vaccines to prevent infection with SARS-CoV-2, the virus that causes COVID-19, have been authorized for emergency use by the U.S. Food and Drug Administration (FDA). These include two mRNA vaccines produced by Pfizer and Moderna, and one viral vector vaccine produced by Johnson & Johnson’s Janssen. All three vaccines met the safety and effectiveness requirements to obtain FDA’s Emergency Use Authorization for the prevention of COVID-19. Despite the scientific data on vaccine safety and efficacy and the known risks of severe illness and death associated with COVID-19, vaccine hesitancy remains a significant barrier to bringing the pandemic to an end.

Addressing vaccine hesitancy around COVID-19 vaccines requires communication approaches that are tailored to different groups in a way that will address their concerns. Data analysis can inform the development of such strategies. To support state and local communication and outreach efforts, this analysis explores vaccine hesitancy among different geographic areas and sociodemographic groups, models which factors are associated with vaccine hesitancy, and examines changing trends over time.

Background

Vaccine Hesitancy

Vaccine hesitancy refers to a continuum of beliefs and behaviors around whether or not to accept vaccinations,¹ ranging from complete refusal to complete acceptance.² Hesitancy can lead individuals to delay or adjust recommended vaccination schedules, only vaccinate partially, or decline all vaccines.³ Vaccine hesitancy is an important issue not just for COVID-19 but for pre-existing infectious diseases as well; declining rates of vaccination can threaten herd immunity if they fall below a certain threshold, which varies by disease.⁴ In addition to other mitigation factors, administering vaccinations during an outbreak is a critical component to reducing associated illnesses and deaths. Consequently, refusal of vaccinations can impact how quickly an outbreak may be controlled.

COVID-19 Vaccine Hesitancy

Overcoming hesitancy issues for COVID-19 vaccines is essential for ensuring vaccine coverage in enough of the population to reduce transmission of SARS-CoV-2 and end the COVID-19 pandemic. During the latter part of 2020, as multiple COVID-19 vaccines were in the last phase of clinical trials and showing promising initial results, many Americans expressed hesitancy around these vaccines, indicating concerns about possible side effects, distrust of government oversight to ensure safety, and concerns that the vaccines were too new.⁵ This analysis explores how vaccine hesitancy has evolved in the early months of 2021, as COVID-19 vaccinations became available to segments of the general public.

¹ Salmon, A., Dudley, M.Z., Glanz, J.M., Omer, S.B. (2015). Vaccine hesitancy: Causes, consequences, and a call to action, *Vaccine*, 33 (Suppl. 4):D66-D71, <https://doi.org/10.1016/j.vaccine.2015.09.035>.

² Leask, J., Kinnersley, P., Jackson, C., Cheater, F., *et al.* (2012). Communicating with parents about vaccination: A framework for health professionals. *BMC Pediatrics*, 12: 154, <https://doi.org/10.1186/1471-2431-12-154>.

³ McClure, C.C., Cataldi, J.R., O'Leary, S.T. (2018). Vaccine hesitancy: Where We are and where we are going. *Clinical Therapeutics*, 39(8):1550-1562. <https://doi.org/10.1016/j.clinthera.2017.07.003>. Epub 2017 Jul 31. PMID: 28774498.

⁴ Dubé, E., Laberge, C., Guay, M., Bramadat, P., Roy, R., Bettinger, J.A. (2013). Vaccine hesitancy: An overview. *Human Vaccines & Immunotherapeutics*, 9:8, 1763-1773, <https://doi.org/10.4161/hv.24657>.

⁵ Hamel, L., Kirzinger, A., Muñana, C., and Brodie M. KKF COVID-19 Vaccine Monitor: December 2020. The Kaiser Family Foundation, December 15, 2020. Available at <https://www.kff.org/coronavirus-covid-19/report/kff-covid-19-vaccine-monitor-december-2020/>; last accessed April 22, 2021.

Methods and Data

Data

ASPE examined sociodemographic factors and trends in vaccine hesitancy using survey data from the U.S. Census Bureau's Household Pulse Survey (HPS). In addition, ASPE developed estimates of hesitancy rates at the county and local levels using the 2019 American Community Survey (ACS) 1-year Public Use Microdata Sample (PUMS).

The HPS is nationally representative and includes information on U.S residents' vaccination for COVID-19, intentions to receive the COVID-19 vaccine when available, reasons for hesitancy to receive a vaccine as well as other sociodemographic and geographic (state, region and metropolitan statistical areas) information. We utilized data from the HPS collection periods January 6-18, 2021 to March 17-29, 2021. Each survey during this period was sampled from approximately 1.04 million housing units and had an overall weighted response rate between 6.4 percent (68,348 respondents) and 7.4 percent (77,104 respondents).⁶ The ACS is a nationally representative survey, and it provides key sociodemographic and geographic information, which we used to analyze vaccine hesitancy at the regional, state, and county levels, as well at the level of the ACS's public use microdata areas (PUMA), which are areas within states of roughly 100,000 people. The 2019 ACS had a housing unit response rate of 86 percent (or 2,599,171 million respondents).⁷

Defining Vaccine Hesitancy

We use the HPS survey question, *"Once a vaccine to prevent COVID-19 is available to you, would you...get a vaccine?"*, which provides the following options: 1) "definitely get a vaccine"; 2) "probably get a vaccine"; 3) "probably not get a vaccine"; 4) "definitely not get a vaccine." We use two definitions to capture the strength of hesitancy to receive a vaccine. We call the first "Hesitancy," and it includes survey responses indicating that a person would "probably not" or "definitely not" receive a COVID-19 vaccine when available. We refer to the second definition as "Strong Hesitancy," and it includes include only survey responses indicating that a person would "definitely not" receive a COVID-19 vaccine when available.

⁶ U.S. Census Bureau, Source and Accuracy Statements. Household Pulse Survey: March 17, 2021 – March 29, 2021. Available at https://www2.census.gov/programs-surveys/demo/technical-documentation/hhp/Phase3_Source_and_Accuracy_Week_27.pdf, last accessed May 25, 2021.

⁷ U.S. Census Bureau, American Community Survey Response Rates, <https://www.census.gov/acs/www/methodology/sample-size-and-data-quality/response-rates/>, last accessed May 25, 2021.

Our sample includes individuals who responded “yes” or “no” to having received the COVID-19 vaccine and excludes respondents for whom there was no response. Those answering “yes” to having already received the vaccine are therefore treated as “not hesitant,” as are those who responded “definitely” or “probably” as to their intent to get a vaccine. For those who answered “no” to having received the COVID-19 vaccine or who said they do not intend to receive all required doses, the surveys also asks, “Which of the following, if any, are reasons that you [only probably will /probably won’t/definitely won’t] [get a COVID-19 vaccine/won’t receive all required doses of a COVID-19 vaccine]?”. In addition to intent to vaccinate, we also explore reasons provided by respondents for vaccine hesitancy.

Predicting Vaccine Hesitancy Rates

Our statistical analysis occurred in two steps. First, using the HPS, we used a logistic regression to analyze predictors of vaccine hesitancy using the following sociodemographic and geographic information: age, gender, race/ethnicity, education, marital status, health insurance status, household income, state of residence, and interaction terms between race/ethnicity and having a college degree.

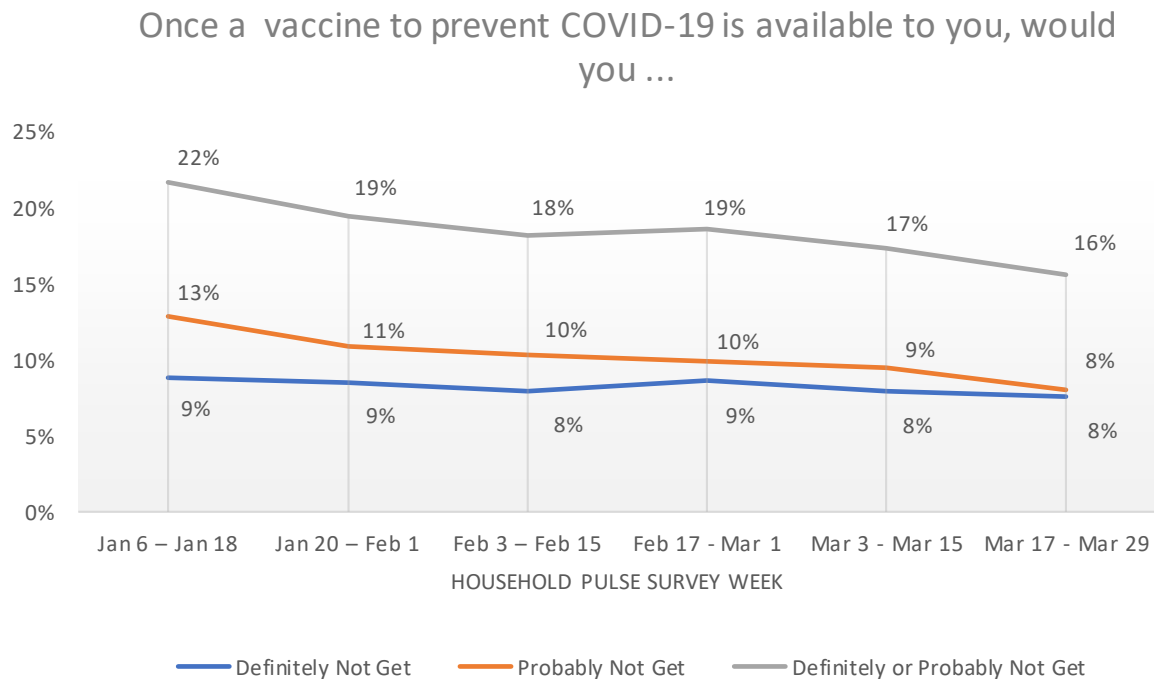
Second, we applied the regression coefficients from the HPS analysis to the data from the ACS to predict hesitancy rates for each ACS respondent ages 18 and older. We then averaged the predicted values by the appropriate unit of geography, using the ACS survey weights, to develop area-specific estimates of hesitancy rates. See Appendix 1 for additional methodological information.

Results

Changes in Vaccine Hesitancy Over Time

Figure 1 presents the percentage of those ages 18 years and older who were hesitant about receiving a COVID-19 vaccine between January and March 2021. The percent of respondents indicating they will “definitely not” or “probably not” receive a vaccine, which we classify as being “hesitant,” decreased from 22 percent to 16 percent during this period (p-value <0.001). In order to understand underlying the dynamics behind these changes, Figure 1 separates the “hesitant” group into those who responded “definitely not” or “probably not.” The decrease in hesitancy was driven by a decline in the number reporting they will “probably not” receive the COVID-19 vaccine when available. By contrast, the percent of respondents indicating they will “definitely not” get a vaccine, referred to as the “strongly hesitant,” has decreased by only about 1 percentage point over time (p-value < 0.001).

Figure 1. Vaccine hesitancy over time



Source: ASPE analysis of the Household Pulse Survey for January 6-18, 2021-March 17-29, 2021

Demographic Predictors of Vaccine Hesitancy

Table 1 summarizes hesitancy rates by select demographic characteristics for the HPS survey administered between January 6-18, 2021 and March 17-29, 2021, and the change between the two survey periods.⁸ There was variation in hesitancy rates when examining groups by gender, age groups, race/ethnicity and college completion. Hesitancy was slightly higher in women than men in January but it was about the same in March. In the two survey periods shown, hesitancy was lowest among those 65 and older and highest among the 25-39 age group. When examining hesitancy by race/ethnicity, it was lowest among Asian (non-Hispanic) respondents in both survey periods. Generally, hesitancy rates were higher among those without a college degree. Assessing the interaction of race and education, the largest gap in hesitancy between the college and non-college groups was among those in the Other/Multiple Race group.

⁸ In Table S-1, we present demographic characteristics of respondents classified as Hesitant and Strongly Hesitant to take the COVID-19 vaccine in the Household Pulse Survey over time. Table S-1 also presents the demographic characteristics of the 2019 ACS PUMS to facilitate comparison of the demographic composition of respondents in the HPS and 2019 ACSPUMS.

Overall, vaccine hesitancy has decreased significantly within nearly all demographic groups over time. The hesitancy rate among women has decreased by 7 percentage points (from 23 percent to 16 percent), compared to a 5 percentage-point decline for men (from 21 percent to 16 percent). Similar declines in hesitancy were observed among the age groups presented, with the greatest decline being observed in those ages 18-24 (from 26 percent to 18 percent). Within race/ethnic groups, hesitancy rates showed the greatest improvement among Black non-Hispanic persons, going from 34 percent to 18 percent (a decrease of 16 percentage points).

Table 1. Hesitancy by Demographic Characteristics: January 6-18 vs. March 17-29			
Demographic Characteristic	Jan 6 - Jan 18	Mar 17 - Mar 29	Net Change
Male	21%	16%	-5%***
Female	23%	16%	-7%***
Age: 18-24	26%	18%	-8%***
Age: 25-39	29%	22%	-7%***
Age: 40-54	25%	18%	-7%***
Age: 55-64	17%	12%	-6%***
Age: 65+	11%	7%	-4%***
White (non-Hispanic)	21%	16%	-5%***
Black (non-Hispanic)	34%	18%	-16%***
Asian (non-Hispanic)	7%	5%	-3%***
Other/Multiple Race	32%	24%	-8%***
Hispanic	19%	13%	-5%***
Non-College White (non-Hispanic)	26%	20%	-5%***
College White (non-Hispanic)	11%	8%	-3%***
Non-College Black (non-Hispanic)	36%	21%	-15%***
College Black (non-Hispanic)	28%	9%	-19%***
College Non-College Asian (non-Hispanic)	11%	6%	-4%***
College Asian (non-Hispanic)	5%	3%	-2%***
Non-College Other/Multiple Race	36%	27%	-9%***
College Other/Two-Race	19%	16%	-2%***
Non-College Hispanic	20%	14%	-6%***
College Hispanic	13%	10%	-3%***

*Note: Hesitancy is defined to include those who responded, “will definitely not” or “definitely not” intend to receive a COVID-19 vaccine when available. *** p-value < 0.001; ** p-value < 0.01; * p-value < 0.05 of two-tailed t-tests. Source: ASPE analysis of the Household Pulse Survey for January 6-18, 2021-March 17-29, 2021*

Changing Patterns of Vaccine Hesitancy Over Time

Table 2 shows the odds ratios from the model used to predict hesitancy for surveys administered between January 6-18, 2021 and March 17-29, 2021.⁹ The results indicate that several factors were significantly associated with higher odds of being hesitant in both time periods: younger age, lower income, and being uninsured or having Medicaid. People with college degrees were less likely to be hesitant than those without a degree, and this difference increased over time for most groups. Patterns by race/ethnicity varied over time, with elevated hesitancy rates among Blacks compared to Whites in January having disappeared by March.

Table 2. Odds Ratios: Factors Associated with Hesitancy Over Time			
Demographic Characteristic		Jan 6 – Jan 18	Mar 17 - Mar 29
Age	18-24	Ref.	Ref.
	25-39	1.35***	1.48***
	40-54	1.02	1.06
	55-64	0.58***	0.54***
	65+	0.33***	0.27***
Gender	Male	0.86***	0.98
	Female	Ref.	Ref.
Race/Ethnicity	White (non-Hispanic)	Ref.	Ref.
	Black(non-Hispanic)	1.28***	0.87***
	Hispanic	0.54***	0.45***
	Asian (non-Hispanic)	0.31***	0.25***
	Other/Multiple race	1.34***	1.22**
College * Race/Ethnicity	White(non-Hispanic)	Ref.	Ref.
	Black(non-Hispanic)	2.18***	1.19
	Hispanic	1.91***	2.45
	Asian, not Hispanic	1.29*	1.43
	Other/Multiple Race	1.28***	1.74
Education	Less than high school	Ref.	Ref.
	High school	0.91*	0.89*
	Some college	0.65***	0.64***
	College or higher	0.28***	0.26***
Marital status	Married	Ref.	Ref.

⁹ Table S-2 presents the odds ratios for the regression estimating strong hesitancy.

Table 2. Odds Ratios: Factors Associated with Hesitancy Over Time			
Demographic Characteristic		Jan 6 – Jan 18	Mar 17 - Mar 29
	Widowed	1.07	1.40***
	Divorced/Separated	1.39***	1.18***
	Never Married	1.00	0.86***
	Missing	1.34	1.15
Health Insurance	Private Health Insurance	Ref.	Ref.
	Medicare	0.76***	1.13*
	Medicaid	1.22***	1.54***
	Other Health Insurance	1.43***	1.58***
	Uninsured	1.37***	1.71***
	Missing Health Insurance	1.06	1.08
Income	Less than \$25,000	Ref.	Ref.
	\$25,000-\$35,000	0.91*	0.98
	\$35,000-\$50,000	0.83***	1.05
	\$50,000-\$75,000	0.82***	0.89*
	\$75,000-\$100,000	0.97	0.99
	\$100,000-\$150,000	0.80***	0.85**
	\$150,000-\$200,000	0.65***	0.83*
	More than \$200,000	0.46***	0.63***
	Did not report	1.02	1.03
Constant		0.85	0.55***

Notes: Hesitancy is defined to include those who responded, “will definitely not” or “definitely not” intend to receive a COVID-19 vaccine when available. The model uses state fixed effects. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

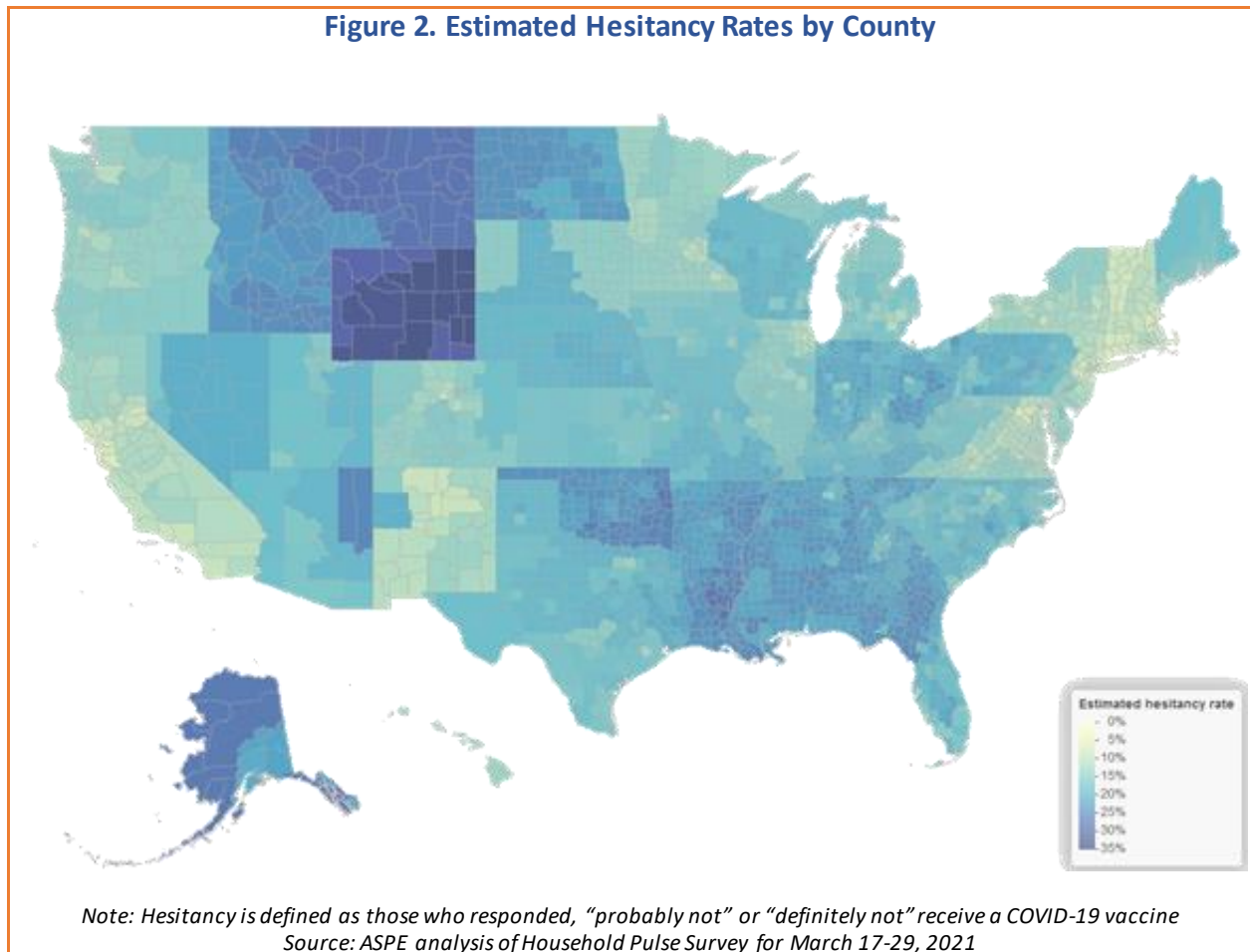
Source: ASPE analysis of the Household Pulse Survey for January 6-18, 2021-March 17-29, 2021

Geographic Patterns of Vaccine Hesitancy

Error! Reference source not found. Figure 2 presents estimated hesitancy rates by counties for March 17-29, 2021, where the lightly shaded areas denote rates below 20 percent and darker areas represent hesitancy rates greater than 20 percent (See Figure S-5 for estimates of hesitancy rates by PUMA).¹⁰ There was substantial variation in hesitancy rates across geographic areas. Vaccine hesitancy rates were the lowest on the West Coast and in the Northeast, and highest in the South, Great Plains and Alaska.

¹⁰ For additional information and data on this topic, please see, <https://aspe.hhs.gov/pdf-report/vaccine-hesitancy>, and <https://aspe.hhs.gov/pdf-report/vaccine-hesitancy-covid-19-puma-estimates>, last visited April 22, 2021.

Figure 2. Estimated Hesitancy Rates by County



Reasons for Vaccine Hesitancy

Figure 3 shows the reasons for being hesitant about receiving a COVID-19 vaccine over time.¹¹ About 50 percent cited vaccine safety concerns; at least 20 percent said they didn’t believe they needed it; and about 30 percent cited lack of trust in vaccines or the government.¹²

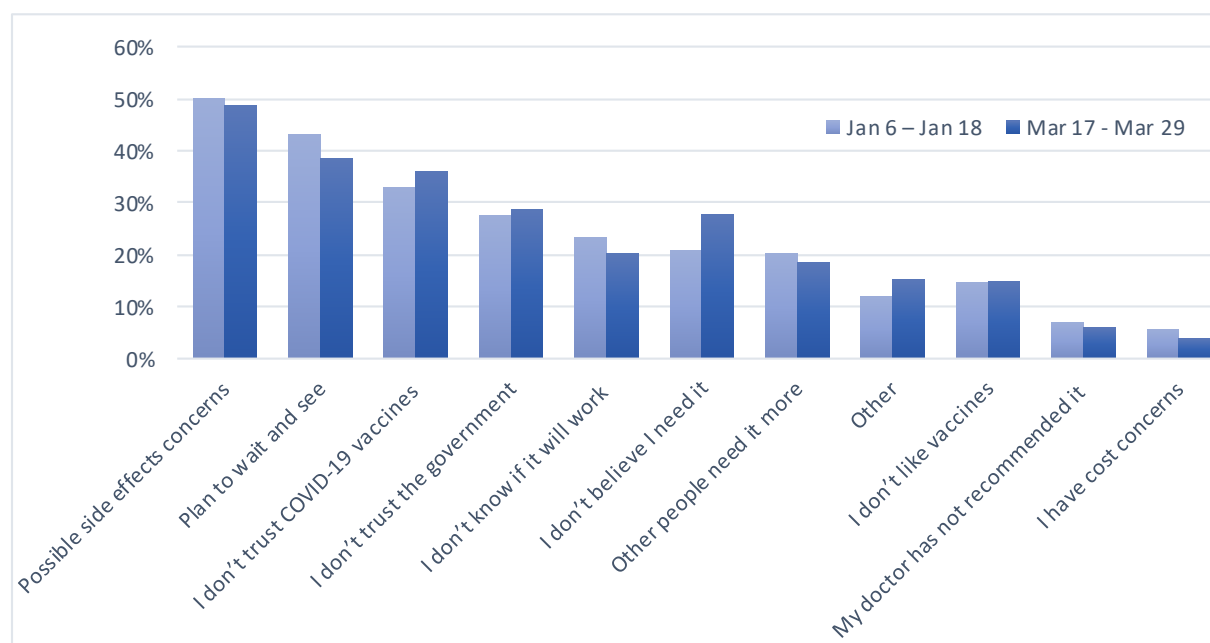
The percent of respondents who selected the reasons “I plan to wait and see if it is safe and may get it later”, or “I don’t know if a COVID-19 vaccine will work” has shown the greatest decrease over time. By contrast, the percent of respondents indicating hesitancy because “I don’t believe I need a COVID-19 vaccine” has increased by 7 percentage points. Further, the percent of respondents indicating “I don’t trust COVID-19 vaccines” has steadily increased.

¹¹ Respondents may select multiple reasons for hesitancy to receive the COVID-19 vaccine.

¹² The survey instrument asks, “Which of the following, if any, are reasons that you [only probably will /probably won’t/definitely won’t] get a COVID-19 vaccine?”.

In Figure S-1 to Figure S-4, we present the reasons for hesitancy by select demographic characteristics in March 17-29, 2021. Among those who said they will “probably” or “definitely not” get a COVID-19 vaccine, those in the 18-25 age group were twice as likely to say they do not believe they need a COVID-19 vaccine (40 percent) than those 65 and older (19 percent). Men were more likely than women to cite lack of trust in government as their reason for not wanting a vaccine (36 percent to 22 percent). Respondents with higher levels of education were more likely to say they were concerned about possible side effects (57 percent for college graduates vs. 45 percent for high school graduates and 36 percent for those without a high school diploma).

Figure 3. Reasons for Hesitancy About Receiving a COVID-19 Vaccine



Note: Respondents may select multiple reasons for hesitancy.

Source: ASPE analysis of Household Pulse Survey, January 6-18 - March 17-29, 2021

Discussion

Since the first COVID-19 vaccine was authorized for emergency use in December 2020, millions of Americans have been vaccinated against COVID-19. However, despite the strong safety and efficacy data and increasing vaccination rates (

Figure S-6), many Americans remain hesitant to be vaccinated against COVID-19. Vaccine hesitancy is complex and multifaceted. Many factors influence vaccine-decision making, including cultural norms, social and peer influences, political views, and other factors that are

specific to an individual or group, as well as concerns regarding specific vaccines. Our analysis shows that differences in intent to get vaccinated for COVID-19 still exist between racial and ethnic groups, ages, education, socioeconomic status, and geographic areas, though overall hesitancy rates have fallen over the early part of 2021.

Other studies have found similar differences in vaccine hesitancy between demographic groups. A December 2020 poll from the de Beaumont Foundation identified the highest rates of vaccine hesitancy among those living in rural communities, Blacks, and Republicans.¹³ As COVID-19 vaccines were administered more widely in the early months of 2021, vaccine hesitancy among these groups generally decreased. For example, a recent study showed significant declines in vaccine hesitancy among Black and Hispanic respondents between October 2020 and March 2021.¹⁴ However, gaps in vaccine confidence persist among specific demographics.^{15,16} Our analysis is consistent with these other findings of vaccine hesitancy presenting differently between racial and ethnic groups, education level, and geographic areas.

Encouragingly, intention to get vaccinated is increasing across most groups—and showing the greatest improvement among non-Hispanic Black adults. This trend has been observed in several other recent studies.^{17,18} However, there is still a significant percentage of individuals expressing hesitancy to vaccinate. The percentage of respondents indicating that they would “definitely not” get a COVID-19 vaccine, defined in our analysis as “strongly hesitant,” has not changed considerably over time. Other studies have found similar results. For example, a poll by Axios/Ipsos conducted in April 16-19, 2021, concluded that 20 percent of respondents said

¹³ de Beaumont Foundation. Poll: The language of vaccine acceptance, available at <https://debeaumont.org/changing-the-covid-conversation/vaccineacceptance/>; last accessed April 22, 2021.

¹⁴ Daly M, Jones A, Robinson E. Public Trust and Willingness to Vaccinate Against COVID-19 in the US From October 14, 2020, to March 29, 2021. JAMA. Published online May 24, 2021. doi:10.1001/jama.2021.8246

¹⁵ Hamel, L., Lopes, L., Sparks, G., Stokes, M., Brodie, M. KFF COVID-19 Vaccine Monitor: April 2021. The Kaiser Family Foundation, March 30, 2021. Available at <https://www.kff.org/coronavirus-covid-19/poll-finding/kff-covid-19-vaccine-monitor-april-2021/>; last accessed May 19, 2021.

¹⁶ Hamel, L., Lopes, L., Kearney, A., Brodie, M. KFF COVID-19 Vaccine Monitor: March 2021. The Kaiser Family Foundation, March 30, 2021. Available at <https://www.kff.org/coronavirus-covid-19/poll-finding/kff-covid-19-vaccine-monitor-march-2021/>; last accessed April 22, 2021.

¹⁷ Funk, C., and Tyson A. Growing share of Americans say they plan to get a COVID-19 vaccine or already have. The Pew Research Center Science & Society, March 5, 2021. Available at <https://www.pewresearch.org/science/2021/03/05/growing-share-of-americans-say-they-plan-to-get-a-covid-19-vaccine-or-already-have/>; last accessed April 22, 2021.

¹⁸ Hamel, L., Lopes, L., Sparks, G., Stokes, M., Brodie, M. KFF COVID-19 Vaccine Monitor: April 2021. The Kaiser Family Foundation, March 30, 2021. Available at <https://www.kff.org/coronavirus-covid-19/poll-finding/kff-covid-19-vaccine-monitor-april-2021/>; last accessed May 19, 2021.

they are not at all likely to get the vaccine as soon as it is available to them; a number that has remained steady since early January 2021.¹⁹ Monthly polls administered by the Kaiser Family Foundation from December 2020 through April 2021 have also shown a steady percentage of respondents indicating that they would “definitely not” get a COVID-19 vaccine, including when broken down by race, ethnicity, or political affiliation.²⁰ These results indicate that a subset of the population is unlikely to accept a COVID-19 vaccine. Therefore, efforts to combat vaccine hesitancy should be focused on moving those individuals who say that they might receive a COVID-19 vaccine, sometimes referred to as the “moveable middle,” from being hesitant to deciding to vaccinate. Beginning in late April, the HPS added an option for respondents to indicate that they are “unsure” about whether to get a COVID-19 vaccine. This additional option may better capture the individuals that may most benefit from targeted messaging to address their reasons for vaccine hesitancy.

Further examination of the underlying reasons for vaccine hesitancy highlights the complexity of the issue. Our analysis shows that hesitancy due to side effects or a desire to wait and see how others respond to the vaccine were commonly cited. Moreover, a poll that captured American’s responses to the Janssen COVID-19 vaccine pause in mid-April 2021 indicates that American are staying informed about vaccine safety.²¹ Other recent work has suggested that vaccine hesitancy surrounding the Janssen COVID-19 vaccine pause may have impacted some demographic groups more than others.²² Continuing to monitor the effect of this pause on vaccine hesitancy among all Americans will be critical to ensure continuing progress in combating vaccine hesitancy.

Hesitancy to vaccinate, if it continues, threatens the prospects for controlling the pandemic in the United States. Efforts to combat vaccine hesitancy must be targeted with messages that resonate with the reasons for hesitancy. Since knowing someone who is vaccinated can also

¹⁹ AXIOS. Axios-Ipsos poll: Americans say J&J pause was the right call. Available at <https://www.axios.com/axios-ipsos-poll-johnson-and-johnson-vaccine-pause-a4eefe38-6aca-4a7e-b1d1-02e1b01a3480.html>; last accessed April 22, 2021.

²⁰ Hamel, L., Lopes, L., Sparks, G., Stokes, M., Brodie, M. KFF COVID-19 Vaccine Monitor: April 2021. The Kaiser Family Foundation, March 30, 2021. Available at <https://www.kff.org/coronavirus-covid-19/poll-finding/kff-covid-19-vaccine-monitor-april-2021/>; last accessed May 19, 2021.

²¹ AXIOS. Axios-Ipsos poll: Americans say J&J pause was the right call. Available at <https://www.axios.com/axios-ipsos-poll-johnson-and-johnson-vaccine-pause-a4eefe38-6aca-4a7e-b1d1-02e1b01a3480.html>; last accessed April 22, 2021.

²² Hamel, L., Lopes, L., Sparks, G., Stokes, M., Brodie, M. KFF COVID-19 Vaccine Monitor: April 2021. The Kaiser Family Foundation, March 30, 2021. Available at <https://www.kff.org/coronavirus-covid-19/poll-finding/kff-covid-19-vaccine-monitor-april-2021/>; last accessed May 19, 2021.

result in higher vaccination enthusiasm,²³ identifying trusted messengers at all levels is crucial. Engaging communities and individuals, especially in minority communities, and developing communication materials that are culturally, linguistically, and literacy appropriate will help promote vaccination in communities who are at a higher risk of contracting COVID-19 and experiencing severe outcomes.²⁴

Limitations

This analysis does not attempt to include all potential variables that may impact vaccine hesitancy, and hesitancy is not the sole determinant of vaccination strategy. In other reports, we have examined access to vaccinations and administration rates across states.^{25,26} Thus, our estimates should be used with caution when attempting to generalize beyond the factors examined herein. In addition, our estimates should be used in conjunction with other relevant information. Local contextual information, including trends and data related to vaccine access, community morbidity and mortality, social vulnerability, and vaccine administration can provide additional insights and applicability.

Our estimates use individual level responses intended to capture sentiment within different geographic levels in the U.S. at the time of the survey; careful consideration is advised when examining questions outside of the time period or geographic level assessed in this analysis. Our estimates at the PUMA or county level are subject to greater sampling error and uncertainty due to predictive modeling than those at the state level, and therefore are less precise; accordingly, they should be used with caution for purposes that require precise estimates. Due to nonresponse bias, the HPS may not be fully representative of all U.S. adults

²³ Hamel, L., Kirzinger, A., Munana, C., Brodie, M. KFF COVID-19 Vaccine Monitor: December 2020. Kaiser Family Foundation, December 15, 2021. Available at <https://www.kff.org/coronavirus-covid-19/report/kff-covid-19-vaccine-monitor-december-2020/>; last accessed April 22, 2021.

²⁴ Centers for Disease Control and Prevention. Vaccinate with confidence. CDC's strategy to reinforce confidence in COVID-19 vaccines, December 12, 2020. Available at <https://www.cdc.gov/vaccines/covid-19/downloads/vaccinate-with-confidence.pdf>; last accessed April 22, 2021.

²⁵ Kolbe, A. Factors influencing variation between states in efficiency of COVID-19 vaccine administration. Washington, DC: Office of the Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services. April 2021. Available at <https://aspe.hhs.gov/pdf-report/covid-19-vaccine-administration>; last accessed May 25, 2021.

²⁶ Kolbe, A. Disparities in COVID-19 Vaccination Rates across Racial and Ethnic Minority Groups in the United States. Washington, DC: Office of the Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services. April 2021. Available at <https://aspe.hhs.gov/pdf-report/covid-19-vaccination-disparities>; last accessed May 25, 2021.

and survey-based estimates for vaccination rates may not match data from other sources. A full discussion of limitations associated with the HPS can be found in the survey's technical documentation.²⁷ Finally, the Household Pulse Survey instrument changed in late April by adding the option "unsure" regarding vaccination intent. In that wave of the survey, about 6.7 percent of the respondents answered that they were "unsure", which was largely offset by reductions in the responses "probably" or "probably not" (see Figure S-7). This Issue Brief compares vaccine hesitancy for January vs. March, so it was unaffected by that change, but any comparison of data from before and after April 14, 2021 would likely be biased by this survey change.

Conclusions

Overcoming vaccine hesitancy is essential to slowing transmission of SARS-CoV-2. Our analysis shows hesitancy around COVID-19 vaccines is a significant challenge for public health but also a complex and multi-faceted issue. Continued monitoring of vaccine hesitancy over time is critical for policy decision makers to adjust the communication strategies, including the methods, language and messengers, to improve confidence in COVID-19 vaccines.

²⁷ U.S. Census Bureau. Household Pulse Survey Technical Documentation. Available at <https://www.census.gov/programs-surveys/household-pulse-survey/technical-documentation.html>; last accessed May 20, 2021.

Appendix 1: Methodology

We use the U.S. Census Bureau's Household Pulse Survey (HPS) and the 2019 American Community Survey (ACS). The HPS is designed to capture household experiences during the coronavirus pandemic.⁴ We use seven waves of the HPS Phase 3 public use files beginning in January 6-18, 2021 through March 17-29, 2021. The collection period of January 6-18, 2021 was the first wave in which the survey instrument asked about an individual's intention to receive a COVID-19 vaccine.²⁸ HPS also includes other sociodemographic information such as gender, age, household income, race/ethnicity, educational level, insurance coverage and location of residence (state, region, and metropolitan and micropolitan statistical areas). The ACS is a household survey that captures social, housing and economic information. Like the HPS, the ACS also includes information on gender, age, educational attainment, household income, race/ethnicity, and insurance coverage. In addition to state and region information, the ACS provides smaller geographic areas such as public use microdata areas (PUMAs).²⁹ To create county-level estimates, we used a PUMA-to-county crosswalk from the Missouri Census Data Center. PUMAs spanning multiple counties had their estimates apportioned across those counties based on overall 2010 Census populations. We use the appropriate survey weights to produce summary statistics and to estimate the regression model.

We use a binary logistic regression model characterized by equation (1) to obtain hesitancy estimates in each wave:

$$(1) \text{logit}(H_{i,k}=1 | X, Z) = \alpha + \beta X + s.$$

In equation (1), H_i is equal to one if respondent i in wave k indicated that they would “definitely not” or “probably not” get the COVID-19 vaccine and zero if the response is “definitely”, “probably”, and “yes”. X is a set of sociodemographic characteristics for respondent i in wave k : age (18-24, 25-39, 40-54, 55-64, 65+), gender, race/ethnicity (Hispanic, non-Hispanic White, non-Hispanic Black, non-Hispanic Asian, and Other/Multiple Race), education (less than high school, high school, some college, college or higher), marital status (married, widowed, divorced or separated, never married, missing), health insurance status (employer-sponsored, nongroup private, Medicare, Medicaid, military, Veterans Affairs, Indian Health Services, Other, uninsured, missing), and household income. To examine whether college education has varying impacts on individual's intention to vaccinate, the model considers the interaction between race/ethnicity and college attainment. The model also includes state indicators, s , to capture time-invariant state-specific attitudes or patterns.

We estimated equation (1) separately for different waves of the HPS (in sample) data by state and then use the estimated coefficients in each wave to predict hesitancy rates in the 2019 ACS (out of sample) by PUMAs and counties. This process results in estimated hesitancy rates for each wave that can be used to examine trends over time.

²⁸ Specifically, the question is “Once a vaccine to prevent COVID-19 is available to you, would you ... get a vaccine?”

²⁹ PUMAs represent the most granular level of geography available in the ACS public use file. PUMAs are defined as areas that contain no fewer than 100,000 people.

Appendix 2. Supplementary Analysis

Table S-1. Comparison of Demographic Characteristics of Respondents Classified as Hesitant and Strongly Hesitant to Take COVID-19 Vaccine in the Household Pulse Survey					
Demographic Characteristic		Household Pulse Survey Mar 17 - Mar 29			2019 ACS PUMS
		All	Hesitant	Strongly Hesitant	All
Age	18-24	9%	10%	11%	12%
	25-39	27%	37%	38%	26%
	40-54	26%	30%	28%	24%
	55-64	17%	13%	14%	17%
	65+	22%	9%	9%	21%
Gender	Male	48%	48%	45%	49%
	Female	52%	52%	55%	51%
Race/Ethnicity	White (non-Hispanic)	62%	65%	62%	63%
	Black (non-Hispanic)	11%	13%	15%	12%
	Asian (non-Hispanic)	5%	2%	2%	6%
	Other/Multiple race	4%	6%	6%	3%
	Hispanic	17%	15%	16%	16%
Education	Less than high school	9%	12%	11%	11%
	High school	30%	40%	37%	28%
	Some college	30%	33%	34%	22%
	College or higher	30%	15%	18%	39%
Marital status	Married	54%	48%	47%	50%
	Widowed	4%	4%	4%	6%
	Divorced/Separated	13%	16%	15%	13%
	Never Married	27%	32%	34%	31%
	Missing Marital Status	1%	1%	1%	0%
Insurance	Private Health Insurance	55%	46%	47%	67%
	Medicare	8%	5%	5%	12%
	Medicaid	5%	9%	8%	9%
	Other Health Insurance	2%	2%	2%	2%
	Uninsured	6%	10%	9%	10%
	Missing Health Insurance	26%	28%	28%	0%
Income	Less than \$25,000	10%	13%	13%	12%
	\$25,000-\$35,000	7%	9%	9%	7%
	\$35,000-\$50,000	8%	9%	10%	11%
	\$50,000-\$75,000	13%	12%	12%	17%
	\$75,000-\$100,000	9%	8%	8%	14%
	\$100,000-\$150,000	11%	8%	9%	18%

	\$150,000-\$200,000	5%	3%	3%	9%
	More than \$200,000	6%	2%	2%	10%
	Missing	32%	35%	33%	3%

Source: ASPE Analysis of the Household Pulse Survey for March 17-29, 2021 and the 2019 ACS PUMS

Table S-2. Odds Ratios: Factors Associated with Strong Hesitancy Over Time

Household Pulse Survey			
Demographic Characteristic		Jan 6 – Jan 18	Mar 17 - Mar 29
Age	18-24	Ref.	Ref.
	25-39	1.34***	1.55***
	40-54	1.03	1.27*
	55-64	0.65***	0.59***
	65+	0.34***	0.34***
Gender	Male	0.93*	1.14***
	Female	Ref.	Ref.
Race/Ethnicity	White (non-Hispanic)	Ref.	Ref.***
	Black (non-Hispanic)	1.1	0.71***
	Hispanic	0.47***	0.40***
	Asian (non-Hispanic)	0.21***	0.24***
	Other/Multiple race	1.27***	0.98
College * Race/Ethnicity	White (non-Hispanic)	Ref.	Ref.
	Black (non-Hispanic)	1.75***	0.89
	Hispanic	2.62***	3.03***
	Asian (non-Hispanic)	1.55*	1.02
	Other/Multiple race	1.62***	2.20***
Education	Less than high school	Ref.	Ref.
	High school	0.76***	0.86*
	Some college	0.55***	0.61***
	College or higher	0.22***	0.22***
Marital status	Married	Ref.	Ref.
	Widowed	1.23*	1.31**
	Divorced/Separated	1.28***	1.14**
	Never Married	1.04	0.78***
	Missing	2.19***	1.08
Health Insurance	Private Health Insurance	Ref.	Ref.
	Medicare	0.78**	0.92
	Medicaid	1.32***	1.46***
	Other Health Insurance	1.56***	1.44***
	Uninsured	1.61***	1.86***
	Missing Health Insurance	1.07	0.86*

Income	Less than \$25,000	Ref.	Ref.
	\$25,000-\$35,000	0.90	0.88
	\$35,000-\$50,000	0.73***	0.93
	\$50,000-\$75,000	0.68***	0.83**
	\$75,000-\$100,000	0.90*	0.94
	\$100,000-\$150,000	0.66***	0.74***
	\$150,000-\$200,000	0.62***	0.73*
	More than \$200,000	0.46***	0.7**
	Did not report	1.03	1.22*
Constant		0.27***	0.22***

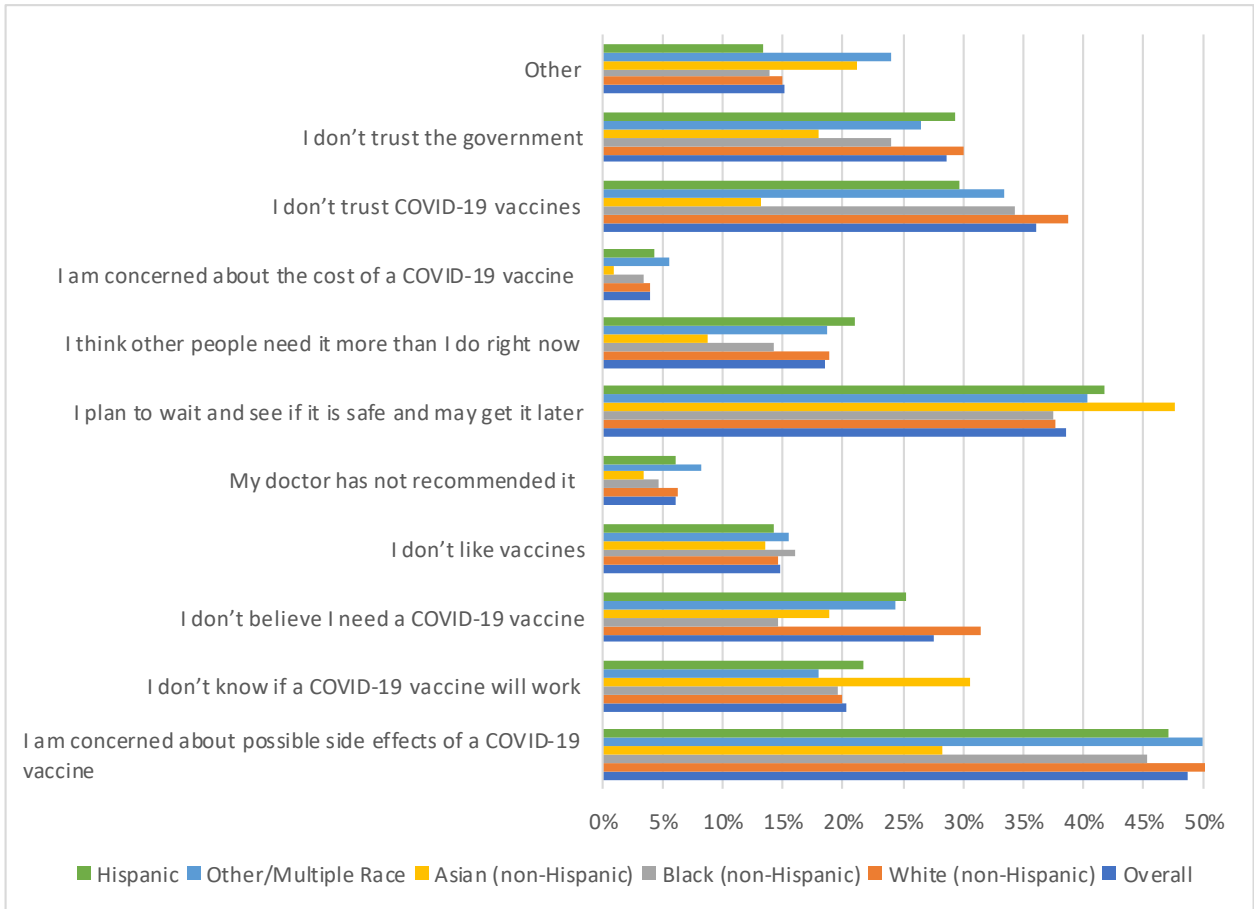
*Notes: Strong Hesitancy is defined to include those who responded, “definitely not” intend to receive a COVID-19 vaccine when available. The model uses state fixed effects. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$*
Source: ASPE analysis of the Household Pulse Survey for January 6-18, 2021-March 17-29, 2021

Figure S-1. Reasons for Hesitancy by Age



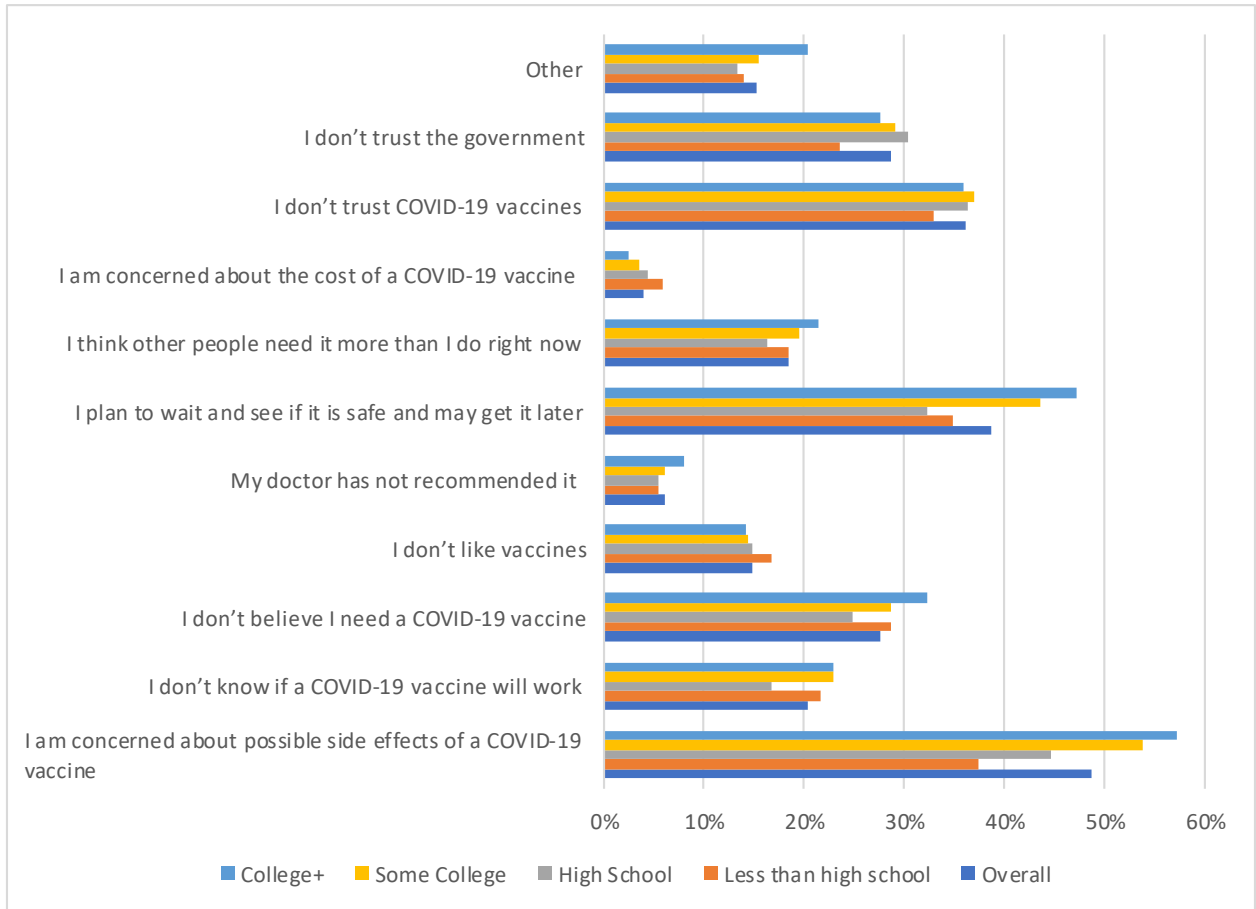
*Note: Respondents may select multiple reasons for hesitancy.
Source: ASPE analysis of Household Pulse Survey, March 17-29, 2021*

Figure S-2. Reasons for Hesitancy by Race/Ethnicity



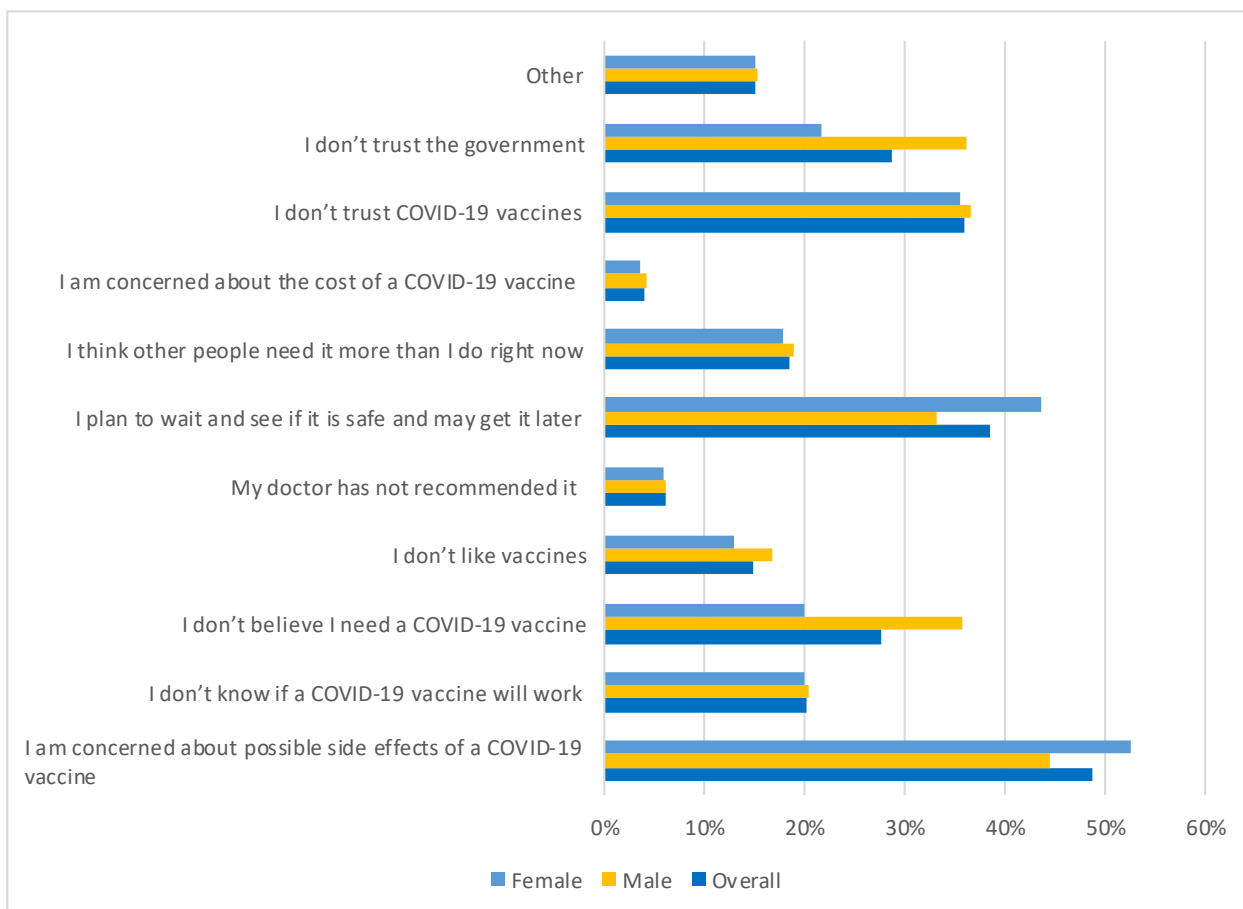
*Note: Respondents may select multiple reasons for hesitancy.
Source: ASPE analysis of Household Pulse Survey, March 17-29, 2021*

Figure S-3. Reasons for Hesitancy by Education



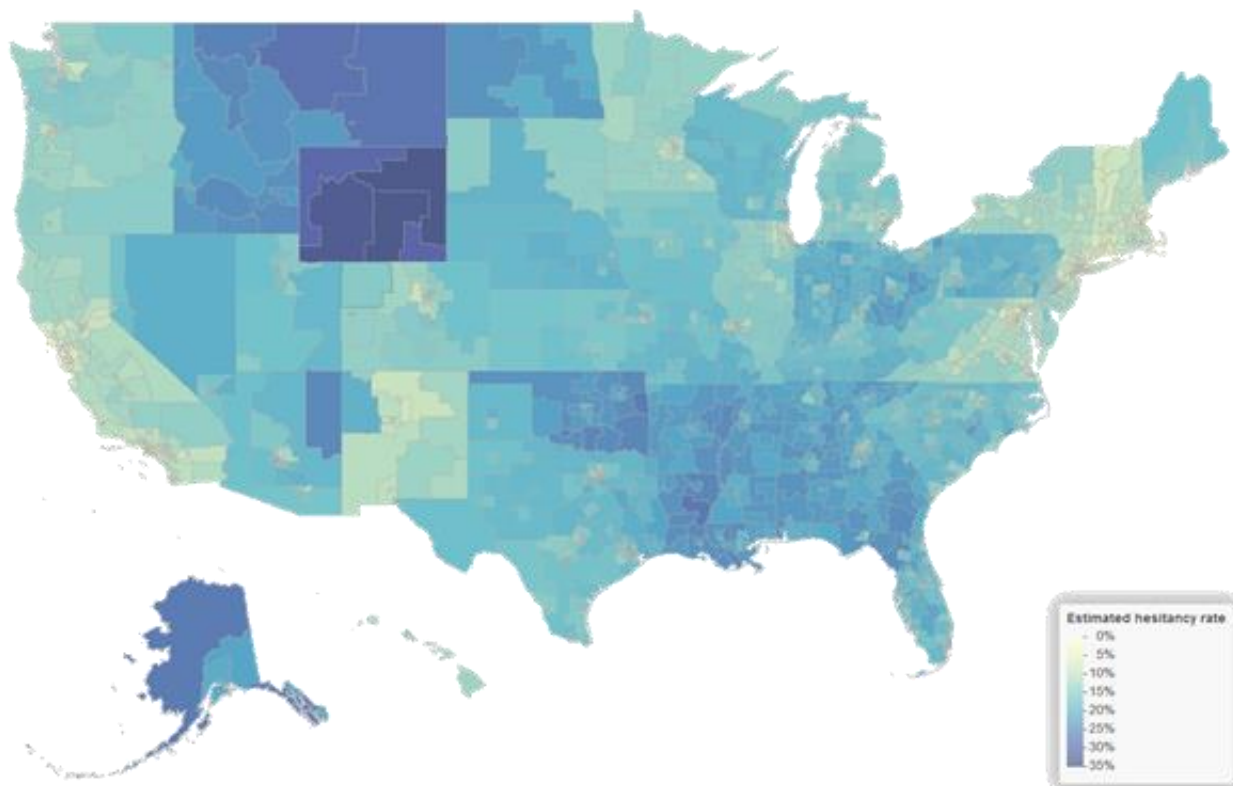
*Note: Respondents may select multiple reasons for hesitancy.
Source: ASPE analysis of Household Pulse Survey, March 17-29, 2021*

Figure S-4. Reasons for Hesitancy by Gender



*Note: Respondents may select multiple reasons for hesitancy.
Source: ASPE analysis of Household Pulse Survey, March 17-29, 2021*

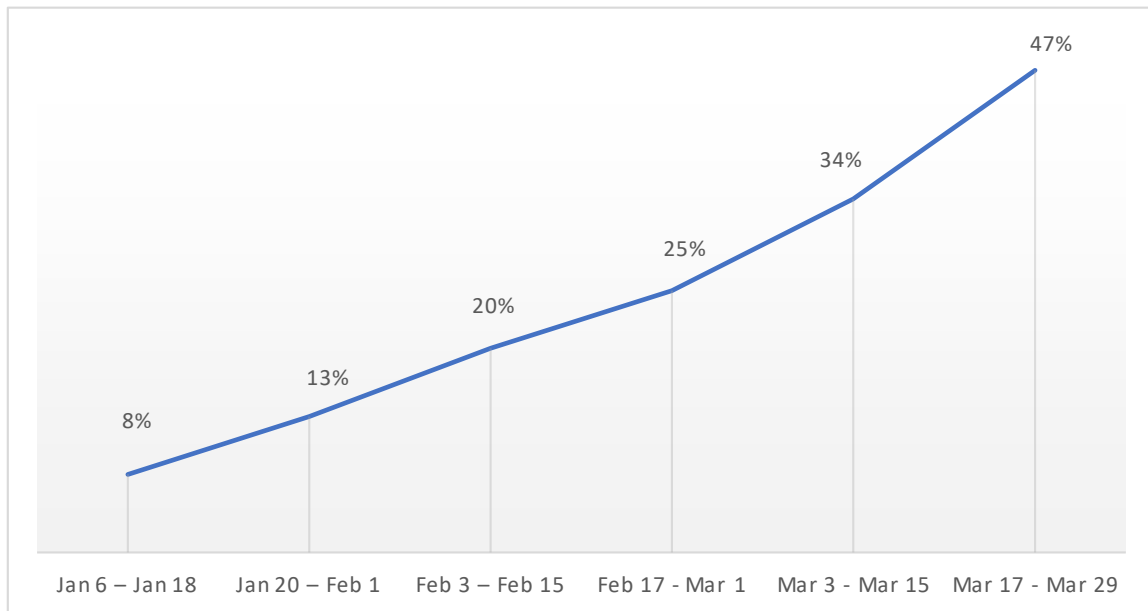
Figure S-5. Estimated hesitancy rates by PUMAs



Note: Hesitancy is defined as those who responded, “probably not” or “definitely not” receive a COVID-19 vaccine

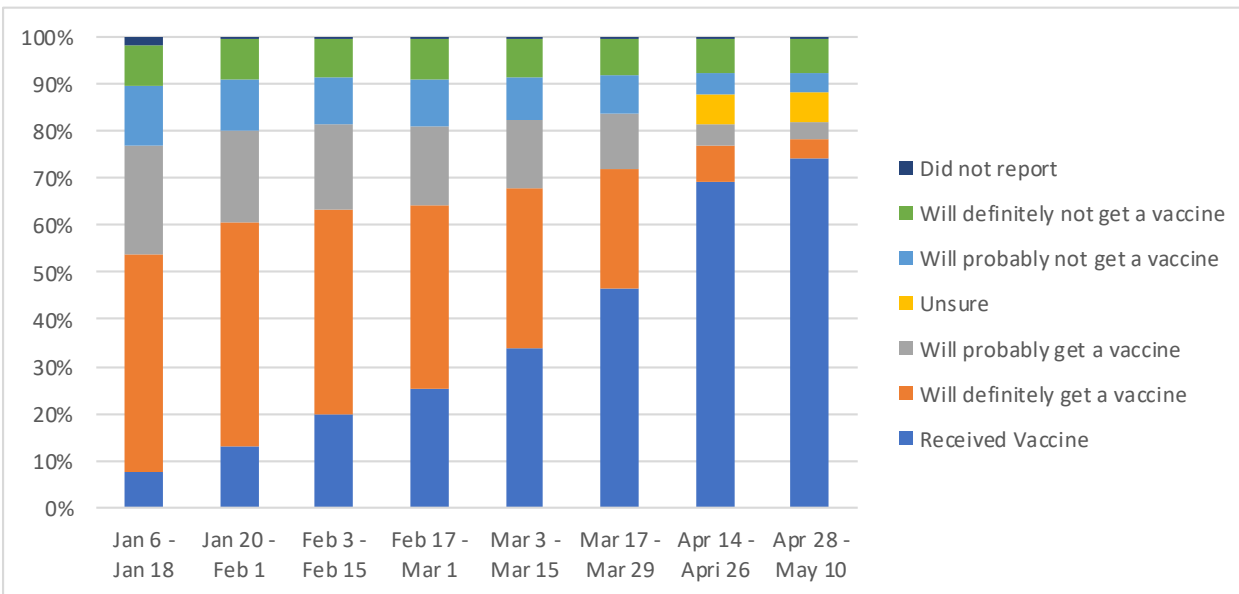
Source: ASPE analysis of Household Pulse Survey for, March 17-29, 2021

Figure S-6. The percent of U.S. adults 18 years and older who reported being vaccinated for COVID-19 over time



Note: Includes U.S. adults 18 years and older who have received at least one dose of a COVID-19 vaccine
Source: ASPE analysis of the Household Pulse Survey, January 6-18, 2021-March 17-29, 2021

Figure S-7. The percent of U.S. adults 18 years and older who reported being vaccinated for COVID-19 over time



Note: Includes U.S. adults 18 years and older who have received at least one dose of a COVID-19 vaccine
Source: ASPE analysis of the Household Pulse Survey, January 6-18, 2021-April 28-May 10, 2021

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